Supporting Analysis Users in U.S. ATLAS

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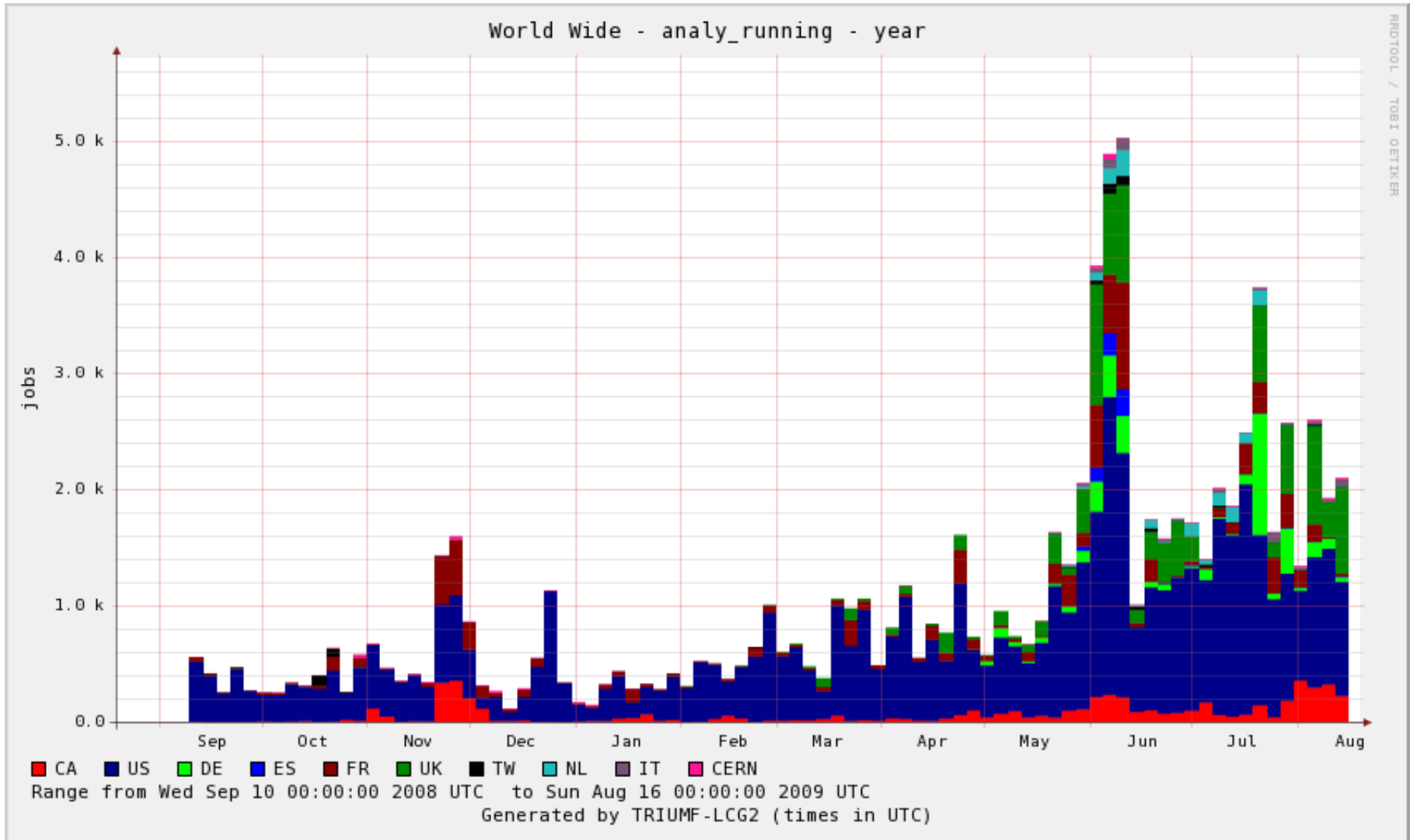
U.S. ATLAS Tier 2/Tier 3 Workshop, UC
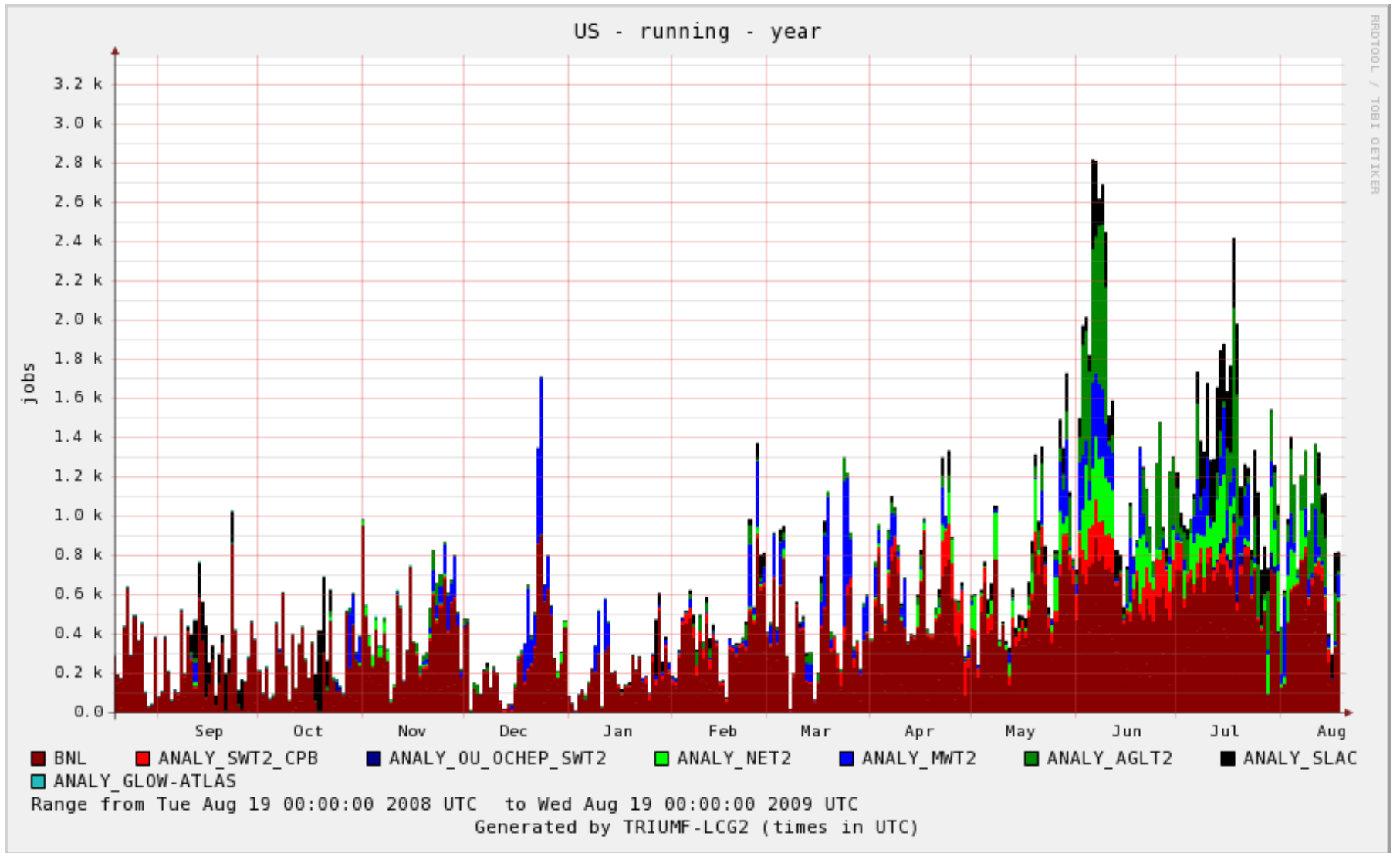
August 19, 2009

Overview

- U.S. ATLAS has excellent track record of supporting users
  - US is the most active cloud in ATLAS for user analysis
  - Analysis sites are in continuous and heavy use for >2 years
  - We have regularly scaled up resources to match user needs
  - But, we do not know if we are at the right scale (we expect user activity to grow significantly when data arrives)
  - We need to steer more users to run analysis at Tier 2's
  - We do not have much experience with supporting users at Tier 3
  - Planning guidance comes from previous talks
  - Tier 3 issues will be discussed tomorrow
  - In this talk, review current user analysis support and operations
  - Discuss plans for future

Analysis Usage Growing

World Wide - analy_running - year

Range from Wed Sep 10 00:00:00 2008 UTC to Sun Aug 16 00:00:00 2009 UTC
Generated by TRIUMF-LCG2 (times in UTC)

Legend: CA US DE ES FR UK TW NL IT CERN

Growing Tier 2 Activity Since May

US - running - year

Range from Tue Aug 19 00:00:00 2008 UTC to Wed Aug 19 00:00:00 2009 UTC
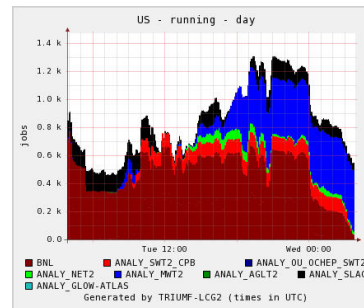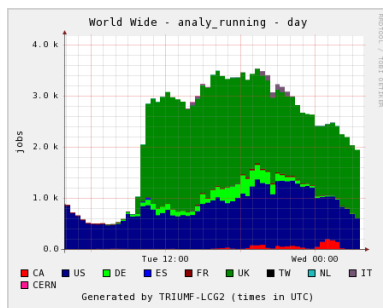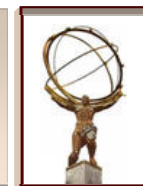Generated by TRIUMF-LCG2 (times in UTC)

Key Ingredients for Analysis Support

- **What structures do we have in place for analysis support**
    - Monitoring and support teams
        - Proactive monitoring and site support at U.S. Tier 1 and Tier 2's
        - Distributed Analysis Shift Team (DAST)
        - ATLAS Distributed Computing Operations Shift (ADCoS)
    - Facilities organization
        - U.S. ATLAS Integration Program
        - U.S. ATLAS Operations Program
    - Testing and validation exercises
        - Jamborees, stress tests, site certification, HammerCloud…
    - Software support
        - U.S. Panda team
    - Users running analysis, very active through hypernews

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Site Monitoring Through Panda

US Sites	Job Nodes	Jobs	Latest	Pilot Nodes	defined	assigned	waiting	activated	sent	running	holding	transferring	finished	failed tot trf other		
Site Name	880	5552	08-19 03:47	546	0	0	0	4988	0	557	40	15569	5552	26% 8% 19%		
ANALY_AGLT2	0	0	offline	0	0	0	0	0	0	0	0	0 / 0	0	0		
ANALY_BNL_ATLAS_1	49	4403	08-19 02:08	92	0	0	0	0	0	6	0	0 / 0	7453	4403	37% 8% 29%	
ANALY_BNL_LOCAL	0	0		40	0	0	0	0	0	0	0	0 / 0	0	0		
ANALY_GLOW-ATLAS	0	0	offline	0	0	0	0	0	0	0	0	0 / 0	0	0		
ANALY_HU_ATLAS_Tier2	0	0	offline	0	0	0	0	0	0	0	0	0 / 0	0	0		
ANALY_IllinoisHEP	7	0	08-19 03:46	4	0	0	0	62	0	3	2	0 / 0	36	0	0% 0% 0%	
ANALY_LONG_BNL_ATLAS	120	285	08-19 03:47	97	0	0	0	0	0	29	3	0 / 0	1838	285	13% 8% 6%	
ANALY_LONG_BNL_LOCAL	0	0		2	0	0	0	0	0	0	0	0 / 0	0	0		
ANALY_MWT2	216	423	08-19 03:47	19	0	0	0	2442	0	447	0	0 / 0	388	423	52% 49% 3%	
ANALY_NET2	109	8	08-19 03:47	40	0	0	0	182	0	23	13	0 / 0	810	8	1% 0% 1%	
ANALY_OU_OCHEP_SWT2	6	8	08-19 00:10	14	0	0	0	0	0	0	0	0 / 0	0	8	100% 0% 100%	
ANALY_SLAC	211	421	08-19 03:47	218	0	0	0	2302	0	49	22	0 / 0	3048	421	12% 3% 9%	
ANALY_SWT2_CPB	162	4	08-19 03:41	20	0	0	0	0	0	0	0	0 / 0	1996	4	0% 0% 0%	
ANALY_UTA	0	0	offline	0	0	0	0	0	0	0	0	0 / 0	0	0		

US 880 5552 08-19 03:47 546 0 0 0 4988 0 557 40 0 / 0 15569 5552 26% 8% 19%

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Distributed Analysis Shift Team – DAST

- User analysis support is provided by the AtlasDAST (Atlas Distributed Analysis Shift Team) since September 29, 2008. Previously, user support was on a best effort basis provided by the Panda and Ganga software developers.

- Nurcan Ozturk (UTA) and Daniel van der Ster (CERN) are coordinating this effort.

- DAST organizes shifts currently in two time zones – US and CERN. One person from each zone is on shift for 7 hours a day covering between 9am-11pm CERN time, and 5 days a week.

- Members in the North American time zone:
  - Nurcan Ozturk (UTA)
  - Sergey Panitkin (BNL)
  - Alden Stradling (UTA)
  - Jakob Searcy (University of Oregon)

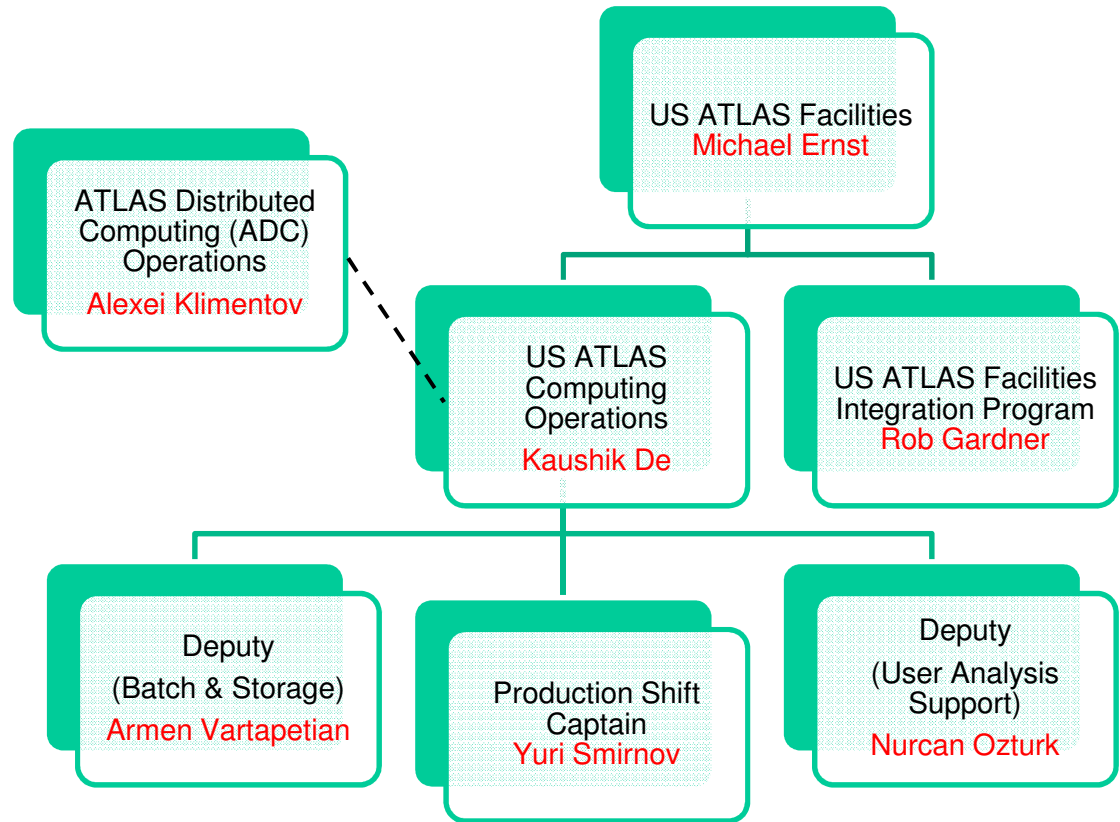Kaushik De

ADCoS (ADC Operations Shifts)

- **ADCoS combined shifts started January 28th, 2008**
  - Coordinated by K. De and Xavier Espinal (PIC/IFAE)

- **ADCoS Goals**
  - World-wide (distributed/remote) shifts
  - To monitor all ATLAS distributed computing resources
  - To provide Quality of Service (QoS) for all data processing

- **Organization**
  - Senior/Trainee: 2 day shifts, Expert: 7 day shifts
  - Three shift times (in CERN time zone):
    - ASIA/Pacific: 0h - 8h
    - EU-ME: 8h - 16h
    - Americas: 16h - 24h

- **U.S. shift team**
  - In operation long before ADCoS was started
  - Yuri Smirnov (captain), Mark Sosebee, Wensheng Deng, Barry Spurlock, Armen Vartapetian, Rupam Das

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Facilities Organization

- See Michael Ernst's talk for overview

- Integration program covered in Rob Gardner's talk

- Operations activity started one year (+few months) ago

US ATLAS Facilities
Michael Ernst

ATLAS Distributed Computing (ADC) Operations
Alexei Klimentov

US ATLAS Computing Operations
Kaushik De

US ATLAS Facilities Integration Program
Rob Gardner

Deputy (Batch & Storage)
Armen Vartapetian

Production Shift Captain
Yuri Smirnov

Deputy (User Analysis Support)
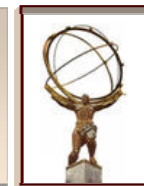Nurcan Ozturk

Data Distribution Issues

- Data distribution plan is in Jim Cochran's talk
  - How many copies of ESD/pDPD's do we need?
    - One copy at Tier 1, one copy among Tier 2's sufficient?
    - Do we have sufficient storage after first run?
  - How many copies of AOD/D1PD is optimal?
    - We are currently making 3-4 copies at US Tier 2's
  - How many copies of DnPD's generated by physics groups?
    - Not done uniformly or regularly yet
    - We expect these to be heavily used
    - Currently, we make 6 copies (Tier 1 + 5 Tier 2's)
    - Space may be a issue in the long run?

- Distribution of data on demand (RAW, ESD, HITS…)
  - Web interface from Panda monitoring page
  - Works well – but requests increasing rapidly
  - We do not have data expiration policy

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Data Management

- Data movement through DQ2/Pandamover works well

- Cleaning up stored data is not easy
  - Data creation is well automated – production can fill up storage
  - Cleaning up is not so easy for a variety of reasons
  - Aborted and obsolete datasets now cleaned automatically in U.S. by ADC ops. (but physicists are reluctant to declare data obsolete)
  - Charles Waldman's scripts to check consistency and clean up
  - Armen/Hiro working on automated user data cleanup strategies

- Data placement not optimized
  - Production jobs have default storage either to tape or disk
  - Once produced, no mechanism to archive rarely used data to tape
  - Currently also missing simultaneous archiving to tape

Testing and Validation

- **Site certification and validation**
    - ❑ Through integration program (organized by Nurcan Ozturk)
    - ❑ Variety of test jobs, new ones added regularly

- **Jamborees**
    - ❑ Regularly organized at BNL, ANL and LBL
    - ❑ Leads to spike in real user analysis
    - ❑ See Jim Cochran's talk

- **Stress tests**
    - ❑ Many U.S. stress tests in the past
    - ❑ Moving towards coordinated tests on all clouds
    - ❑ HammerCloud helps with automation

- **STEP09**

Analysis Site Certification in US

Goal: **certify sites to handle each type of analysis job in advance of the stress tests.**

- ***Job preparations***
- ***Site preparations and ANALY queue profiles***

- ***Metrics***

http://www.usatlas.bnl.gov/twiki/bin/view/Admins/AnalysisSiteCertification.html

Certifications by job type

Notation: 🟢 completed 🔵 work is in progress ⚫ defer to next phase 🔴 table to be updated

Job type	Athena release	input	T1	AGLT2	MWT2	NET2	SWT2	WT2
SusyValidation	14.5.0	AOD	🟢	🟢	🟢	🟢	🟢	🟢
D3PD making with TopPhysTools	14.5.0	AOD	🟢	🟢	🟢	🟢	🟢	🟢
TAG selection	14.5.0	TAG	🟢	🟢	🟢	🟢	🟢	🟢
DB access job	14.5.1.4	AOD	🟢	🟢	🟢	🔵	🔵	🔵
Data reprocessing	14.5.0.5	DPD						
ANLASC1	14.5.1	AOD			🔵	🔵		🔵
ANLASC2	14.2.23	ESD			🔵			
ANLASC2 Jet sampling	14.5.1	ESD			🔵			
More jobs types to come ...								
HammerCloud Jobs								

200 jobs for each type, 95% success rate.

Nurcan Ozturk - UT Arlington

DA During STEP'09 – June 2-12 2009

- Stress testing with HammerCloud
  - "Infinite" real analysis jobs to participating sites (all T2's + a few T1's)
  - Most (~all) of our STEP'09 results drawn from these tests

- Coordinated user activity
  - US and DE challenges

- Background (normal) user activity
  - Some sites were quite busy without HC's help

- HC workflows tested:

  - Classic Athena analyses:
    - various input data sizes: ESD, **AOD**, DPD
    - TAG for direct event access
  - Calibration & Alignment: RAW data and remote DB access
  - Private MC production
  - everything else (ROOT, arbitrary executables...)

HC: Global Summary
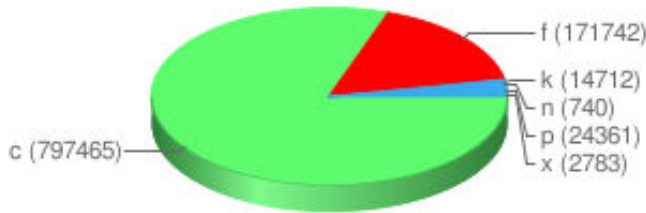
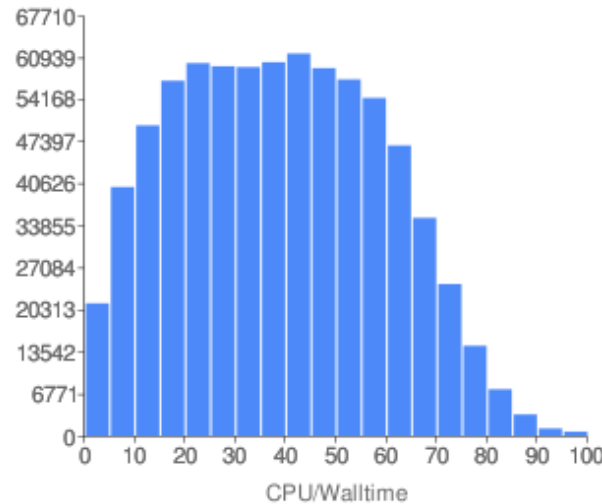~1M jobs submitted -- 82.3% succeeded
Total 26.3B events processed
Mean Events/s = 7.7Hz
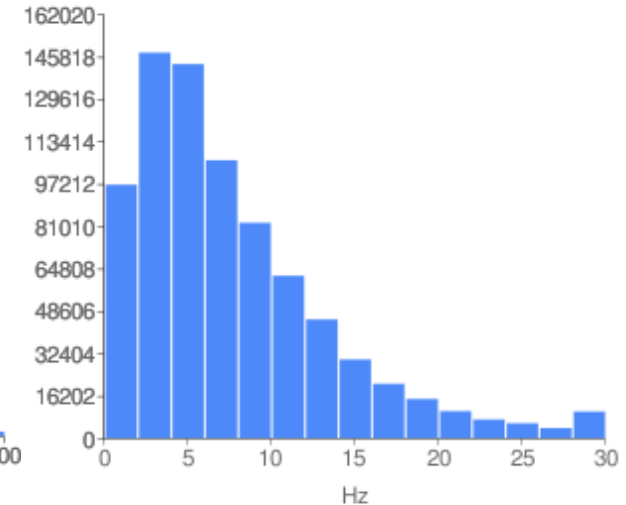Mean CPU/Walltime = 0.39

Overall Efficiency

- c (797465)
- f (171742)
- k (14712)
- n (740)
- p (24361)
- x (2783)

Overall CPU/Walltime

μ=39.3 σ=23.2

Overall Events/s

μ=7.7 σ=6.5

Global Efficiency: 82.3%   Global Rate: 28.6kHz

IT Department

STEP09 - Cloud Summary

Cloud	# Jobs	# Successful	# Failed	Efficiency ▲	#files	#events	Hz	CPU/Wall
US	163004	153240	9764	0.940	465393	4169999722	6.0	33.9
IT	59163	52990	6173	0.896	311061	2798011153	6.5	32.6
NG	16730	14551	2179	0.870	20179	172708698	7.3	
FR	166427	144658	21769	0.869	557571	5050911395	9.3	44.5
ES	72562	62565	9997	0.862	236690	2150478621	10.0	44.3
TW	24178	19544	4634	0.808	86293	833817261	15.2	48.4
UK	181394	145222	36172	0.801	439084	3984651767	7.1	39.8
CA	41890	32306	9584	0.771	87117	757520054	4.2	34.4
DE	176076	135218	40858	0.768	557395	4991372555	7.9	40.8
NL	66632	37171	29461	0.558	154452	1352903529	7.9	35.0

In US sites have been busy with real user jobs.
- 426309 user analysis jobs during STEP09
- 173648 (~40%) from HammerCloud
- Remaining 60% from 198 other users
*   - 172k succeeded, 80k failed (of which*
*   40-50k killed by user)*

User support during STEP09 provided by DAST - Distributed Analysis Support Team:
- normal shift rotation w/o extra effort
- no extraordinary problems or complaints

Next Challenge

- During the summer we have generated massive MC data samples in the U.S.

  - step09.00000011.jetStream_medcut.recon.AOD.a84/
    - jet pt > 35 GeV, 97.69M events, 9.4pb-1 integrated luminosity
    - total size 14900 GB, 9769 files

  - step09.00000011.jetStream_lowcut.recon.AOD.a84/
    - jet pt > 17 GeV, 27.49M events, 0.26 pb-1 integrated luminosity
    - total size 3674 GB, 2749 files

  - Replicated to all US Tier2's

  - Nurcan Ozturk has tested and validated these samples

  - Additional 300M events generated (but not replicated to Tier 2's yet)

- Good sample for beginning students/postdocs

Scaling Up

- Tier 2 usage for analysis is still only ~20% of expected
  - Stress testing and HC has been very useful
  - But we need more real users to create 'chaos'

- Storage and data management issues
  - Required lot of attention during the past year
  - Slowly improving automation of system
  - Fundamental limits (to chaotic large scale data access) are still not fully explored – expect a lot of pain when data arrives

- Direct user support
  - Works well now, but funding is limited – we cannot suddenly add a lot more people to support users when data arrives (currently support model works well)
  - Need to continually automate (design goal of Panda from the beginning) all procedures – especially DDM

Conclusion

- Scaling up will require help from physicists

- We need to spend a larger fraction of our time on automation, instead of fighting fires with manual systems

- We have highly experienced operations team in place (many with >5 years experience with ATLAS grid)

- U.S. ATLAS is doing well – but there is still lot more work to be done before data arrives